

SPECIFICATION

Driving apparatus for water craft

5 The invention relates to driving apparatus for a ship or other water craft, comprising a main thrust generator, such as a propeller, and a drivable auxiliary device, such as a manoeuvring propeller.

For such a driving apparatus, it is desirable to
10 ensure a predetermined rate of delivery of energy, e.g. to impart a predetermined rotary speed, to the auxiliary device while the rotary speed of the main motor varies.

When a main motor or an auxiliary device is
15 referred to in the singular, the plural is intended to be included. Within the meaning of the invention, a motor is understood to be of any kind of driving device, e.g. a steam turbine. Auxiliary devices within the meaning of the invention are fire-fighting de-
20 vices or other auxiliary machines, cross jet rudders, rudder propellers, or other auxiliary manoeuvring devices, and all possible devices which may be driven by the main motor and which are to run at a rotary speed different from that of the main thrust
25 generator driven by the main motor, e.g. the main propeller. The term propeller relates to all devices for producing propulsion, e.g. cycloidal propellers and jet drives.

The invention provides driving apparatus for a
30 water craft, comprising at least one main propeller or thrust generator which is driven by at least one main motor; at least one drivable auxiliary device, e.g. a manoeuvring propeller; an energy generator, e.g. an electro-generator or hydraulic pump, which is
35 drivable by the main motor; an auxiliary motor, driven by the energy generator, for driving the auxiliary device; an adjusting device for adjusting the rate at which energy is delivered by the energy generator or consumed by the auxiliary motor
40 without adjusting the power output of the main motor; and a regulator for controlling the said rate by means of the adjusting device, e.g. to maintain a given rotary speed of the manoeuvring propeller, the regulator comprising a actual value-set value
45 comparator, the actual value being derived from the auxiliary device, means being provided for pre-setting the set value.

The invention will be described further, by way of example with reference to the accompanying
50 drawings, in which:

Figure 1 is a diagram of driving apparatus for a water craft, including a cross jet rudder;

Figure 2 is a block circuit diagram of a regulator, including an actual value-set comparator;

55 *Figure 3* is a graph of the discharge quantity of the pump or the rotary speed of the manoeuvring propeller, respectively, according to *Figure 1*, versus the rotary speed of the motor, with the manual control lever fully displaced;

60 *Figure 4* is a graph of the rotary speed - output characteristic of the main motor, the main propeller, and the auxiliary device, i.e. the manoeuvring propeller.

Figure 1 illustrates driving apparatus for a ship which itself is not shown. The ship is driven by at

least one main propeller 1, which may be a rudder propeller. The main propeller 1 is driven by at least one main motor 2 by way of a clutch 3 (e.g. a switch clutch), a shaft 4, an angle drive 5 (e.g. a bevel wheel gear drive) only the casing of which is indicated, a transmission shaft 6, a second angle drive 7 only the casing of which is shown, and a propeller shaft 8.

For the purpose of manoeuvring, the ship may be driven additionally by at least manoeuvring propeller, e.g. a cross jet rudder 9 which consists
75 substantially of a transverse tunnel 10 which leads from one board wall to the other and a propeller 11 arranged therein. The propellers 1 and 11 are thus transverse to one another.

80 The propeller 11 is driven by a hydraulic motor 12 by way of a driving shaft 13, 13a and an angle drive 14 (e.g. a bevel wheel gear drive) only the casing of which is illustrated and which is arranged in the transverse tunnel. The hydraulic motor 12 receives
85 its energy, i.e. liquid under pressure, through pressure pipes 15, 16 from a pump 17 whose feed rate or pressure is adjustable in a known manner. In the present example, it is a pump having a plurality of cylinders whose discharge volume is adjustable by means of an adjuster device 18. Such pumps with
90 adjuster devices are known and commercially available. A diagrammatically illustrated (known) filler pump 19 makes good any possible leakage losses. The pump 17 is driven by the main motor 2 by way of
95 a driving shaft 20, a clutch 21 (e.g. a switch clutch), and a second driving shaft 22. The other elements of such a hydraulic installation, such as filters and valves, are known and therefore need not be described.

100 The rotary speed of the propeller 11 of the cross jet rudder is pre-selectable at will at a constant rotary speed or at any freely selected rotary speed independently of the main motor 2. For this purpose an actual value - set value comparator 23 is provided.
105 The actual value of the rotary speed is taken off the driving shaft 13, 13a of the propeller 11 by a tachometer generator 24 by way of a belt drive 26 and is transmitted to the actual value - set value comparator 23 by way of electrical leads 27, 28. The set value is adjusted on a pre-setting device 29 by means of a hand lever 30, e.g. by adjustment of a known resistor or potentiometer (not shown), and is fed to the comparator 23 by way of electrical leads
110 31, 32. The result of the actual value - set value comparison is transferred to the adjusting device 18 of the pump 17 by way of electrical leads 33, 34.

Actual value - set value comparators, in particular of electrical kind, are well known; these include
120 Wheatstone bridges based on resistors, capacitors, and inductors, and electronic developments thereof. Furthermore, hydraulic and pneumatic comparators utilising pressure differences are known.

Figure 2 diagrammatically illustrates in block circuit diagram form how the elements referred to above are arranged in the control circuit. The arrow
125 n_M indicates the input of the rotary speed, n_M , of the main motor 2, which drives the pump 17 by way of the shafts 20, 22 (input signal). The pump 17 operates, i.e. delivers liquid at a given rate, dependently upon the position of the adjuster device 18,
130

which thus determines the discharge rate, V_q , of the pump 17. This discharge rate determines the rotary speed, n_q , of the propeller 11 in the transverse tunnel 10 and thus also the transverse thrust S_q

5 which constitutes the output signal. The tachometer generator 24 detects a rotary speed n_T and delivers it as the actual value to the comparator 23 in the form of a voltage U_T . A voltage U_V corresponding to the set value is preset by means of the hand lever 30. As
10 a result of the comparison, the comparator 23 delivers a voltage U_E as a return signal to the drive of the adjuster device 18, which converts this signal to a displacement E .

The graph of Figure 3 illustrates the characteristic
15 curve 35 of the discharge quantity Q of the pump 17 and simultaneously the rotary speed n_q of the propeller 11 dependently upon the rotary speed n_M of the main motor 2 at maximum stroke volume of the pump 17. This stroke volume is obtained at
20 maximum displacement of the hand lever 30. The discharge quantity Q and thus the rotary speed n_q of the propeller 11 can then be selected in the working range lying under the characteristic curve 35. In the lower region a between the rotary idling speed n_l
25 and the speed n_2 of the motor 2 the discharge quantity is limited by the characteristics of the pump 17 itself, in the upper region b between n_2 and n_{max} it is limited by the control circuit (Figure 2).

The graph of Figure 4 illustrates the output L_M of
30 the main motor 2, the output L_P of the main propeller 1, the output L_Q of the manoeuvring propeller 11, and the sum $L_P + L_Q$. In the example according to Figure 4, it has been assumed that the maximum power consumption of the auxiliary drive, i.e. the
35 propeller 11 of the transverse thrust installation, amounts to 40% of the maximum power consumption of the main propeller. It is particularly advantageous that the received sum of the outputs $L_P + L_Q$ exceeds the power available in the upper rotary
40 speed region (upwards of 75% of the maximum speed) of the main motor (hatched area). This has the consequence that the main motor is "pressed", i.e. that it is overloaded. However, this overloading of the main motor is permissible because manoeuvring
45 installations and most of the other auxiliary drives on board are nearly always needed only when the main motor operates in the partial region. Moreover, in particular, manoeuvring installations are employed for only a short period of time.
50 Furthermore, the overload may be indicated by a luminous indicator which is switched by a rotary speed relay at a rotary speed higher than n_5 .

CLAIMS

55 1. Driving apparatus for a water craft, comprising a main thrust generator which is driven by a main motor; a drivable auxiliary device; an energy generator which is drivable by the main motor; an
60 auxiliary motor, driven by the energy generator, for driving the auxiliary device; an adjusting device for adjusting the rate at which energy is delivered by the energy generator or consumed by the auxiliary motor without adjusting the power output of the
65 main motor; and a regulator for controlling the said

rate by means of the adjusting device, the regulator comprising an actual value - set value comparator, the actual value being derived from the auxiliary device, means being provided for pre-setting the set value.

70 2. Driving apparatus as claimed in claim 1, in which the energy generator is an adjustable pump and the auxiliary motor is a hydraulic motor.

3. Driving apparatus as claimed in claim 1 or 2, in
75 which the actual value is derived from the auxiliary device by means of a tachometer.

4. Driving apparatus as claimed in any of claims 1 to 3, in which, at elevated rotary speeds of the main motor, the power consumption of the main thrust
80 generator plus that of the auxiliary device exceeds the power output of the main motor.

5. Driving apparatus as claimed in any of claims 1 to 4, in which the auxiliary device is an auxiliary thrust generator for manoeuvring.

85 6. Driving apparatus substantially as described with reference to, and as shown in, the accompanying drawings.

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which thus determines the discharge rate, V_d , of the pump 17. This discharge rate determines the rotary speed, n_Q , of the propeller 11 in the transverse tunnel 10 and thus also the transverse thrust S_Q which constitutes the output signal. The tachometer generator 24 detects a rotary speed n and delivers it as the actual value to the comparator 23 in the form of a voltage U_a . A voltage U_v corresponding to the set value is preset by means of the hand lever 30. As a result of the comparison, the comparator 23 delivers a voltage U_E as a return signal to the drive of the adjuster device 18, which converts this signal to a displacement E .

The graph of Figure 3 illustrates the characteristic curve 35 of the discharge quantity Q of the pump 17 and simultaneously the rotary speed n_Q of the propeller 11 dependently upon the rotary speed n_M of the main motor 2 at maximum stroke volume of the pump 17. This stroke volume is obtained at maximum displacement of the hand lever 30. The discharge quantity Q and thus the rotary speed n_Q of the propeller 11 can then be selected in the working range lying under the characteristic curve 35. In the lower region *a* between the rotary idling speed n_L and the speed n_1 of the motor 2 the discharge quantity is limited by the characteristics of the pump 17 itself, in the upper region *b* between n_1 and n_{max} it is limited by the control circuit (Figure 2).

The graph of Figure 4 illustrates the output L_M of the main motor 2, the output L_P of the main propeller 1, the output L_Q of the manoeuvring propeller 11, and the sum $L_P + L_Q$. In the example according to Figure 4, it has been assumed that the maximum power consumption of the auxiliary drive, i.e. the propeller 11 of the transverse thrust installation, amounts to 40% of the maximum power consumption of the main propeller. It is particularly advantageous that the received sum of the outputs $L_P + L_Q$ exceeds the power available in the upper rotary speed region (upwards of 75% of the maximum speed) of the main motor (hatched area). This has the consequence that the main motor is "pressed", i.e. that it is overloaded. However, this overloading of the main motor is permissible because manoeuvring installations and most of the other auxiliary drives on board are nearly always needed only when the main motor operates in the partial region. Moreover, in particular, manoeuvring installations are employed for only a short period of time. Furthermore, the overload may be indicated by a luminous indicator which is switched by a rotary speed relay at a rotary speed higher than n_c .

CLAIMS

1. Driving apparatus for a water craft, comprising a main thrust generator which is driven by a main motor; a drivable auxiliary device; an energy generator which is drivable by the main motor; an auxiliary motor, driven by the energy generator, for driving the auxiliary device; an adjusting device for adjusting the rate at which energy is delivered by the energy generator or consumed by the auxiliary motor without adjusting the power output of the main motor; and a regulator for controlling the said

rate by means of the adjusting device, the regulator comprising an actual value - set value comparator, the actual value being derived from the auxiliary device, means being provided for pre-setting the set value.

2. Driving apparatus as claimed in claim 1, in which the energy generator is an adjustable pump and the auxiliary motor is a hydraulic motor.

3. Driving apparatus as claimed in claim 1 or 2, in which the actual value is derived from the auxiliary device by means of a tachometer.

4. Driving apparatus as claimed in any of claims 1 to 3, in which, at elevated rotary speeds of the main motor, the power consumption of the main thrust generator plus that of the auxiliary device exceeds the power output of the main motor.

5. Driving apparatus as claimed in any of claims 1 to 4, in which the auxiliary device is an auxiliary thrust generator for manoeuvring.

6. Driving apparatus substantially as described with reference to, and as shown in, the accompanying drawings.

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